Space Station Space Walk

STS-80 tests to define procedures for station assembly, maintenance

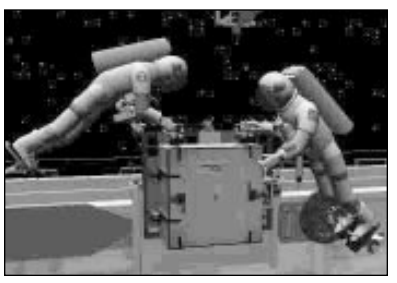
By Karen Schmidt

When construction workers build skyscrapers on Earth they use a crane. International Space Station construction workers also will need a crane, and STS-80 space walkers will give that crane its first on-orbit test next week .

Astronauts Tammy Jernigan and Tom Jones will spend more than 12 hours outside *Columbia* evaluating assembly and maintenance procedures that will be put into practice when assembly of the International Space Station begins. Two space walks will focus on assembly and maintenance tasks including the difficult task of installing or replacing Orbital Replacement Units, or ORUs.

"We want to ensure we have plenty of lessons learned and all of the means, techniques and tools that are being developed right now are tried and true and ready to support space station," said Daryl Schuck, lead EVA officer for STS-80. "During this time, we are also increasing our experience base down here on the ground for flight controllers, hardware designers and crew members."

The space walks are fifth in a series of EVA Development Flight Tests that will help researchers and astronauts build and maintain the International Space Station. The series has focused on evaluation of equipment, tools and procedures that will be used.



During the mission, Jernigan and Jones will make their way into *Columbia*'s cargo bay and Mission Specialist Story Musgrave will assist the space walkers from inside.

Jernigan and Jones will help researchers determine how to best handle the bulky boxes, the ease with which a space walker can remove and replace the box from its "dock" on the shuttle and install it on the station and whether the task can be performed more efficiently by one space walker or two. With this information, researchers can build an ORU docking port and tools that will provide easy removal from a cargo bay, an ORU that can be handled easily and procedures for future station astronauts.

One of the first International Space Station flights, currently set for March 1999, will deliver six large ORUs to the station. All six ORUs will be approximately the same size, mass and shape and will be moved about 80 feet from the shuttle's cargo bay to installation points on the space station.

"What we need to do is transport these large ORUs over a pretty big distance from the payload bay up to their installation location on space station," Schuck said. "That's out of the reach of the existing remote manipulator system so that's why we have these new work platforms."

One of these work platforms is a manually operated EVA crane that can help deliver these bulky masses to the point where they can be installed on the space station.

Jernigan and Jones will remove the crane, stowed in the cargo bay, from its cradle, install it in a fitted socket just above the cradle and perform an equipment checkout. After attaching the ORU to the crane, they will move the crane around to test its capabilities. The crane has four major components—stanchion, crank handles, extendable boom and ORU attachment assembly.

"The crane is manually operated with cranks," Schuck said. "There are three cranks. One controls pitch, another crank controls yaw and moves it from side to side and the third crank controls the extension and retraction of the crane."

Each component of the crane and the tasks involved with assembly, operations and stowing will be evaluated by the crew to assess the ease of performance, the difficulty of the task and even the location of handholds for ease in reaching the crane. The crew has practiced operations in the Weightless Environment Training Facility, but on-orbit operations will determine the exact procedures for space station assembly.

"Mass handling in the water doesn't necessarily give us a very good feeling of what it would really feel like," Schuck said.

He added that factors such as water viscosity and bubbles often greatly distort the movements of large masses such as those being manipulated during the space walks.

The six-foot crane weighs 156 pounds and has a boom that extends from four to 17.5 feet. It is designed to aid astronauts in transporting objects as large as 600 pounds to different work sites. The crane also has an attachment on the end of the boom that provides temporary stowage for an object being replaced during maintenance.

Three handling tools also will be evaluated during the first space walk. Two square scoops and the D-handle will be used to grasp, handle and transport ORUs. The scoops are designed to be used separately or with the add-on D-handle for larger ORUs.

The second space walk on flight day 12 will focus on another work platform. The Portable Work Platform is designed so astronauts can reach various parts of the space station for assembly and maintenance tasks. The PWP consists of three items—the Temporary Equipment Restraint Aid, or TERA; a tool stanchion and the articulating portable foot restraint. The PWP is designed so that the Space Station Remote Manipulator System can grapple it to position tools, equipment and crew members at a specific worksite. Pilot Kent Rominger will operate the shuttle's robot arm from inside *Columbia*.

"We have assembled the work platform before, but never in a free-floating mode," Schuck said. "It will be interesting to see if we can assemble it free-floating." The PWP flew before during an earlier on STS-72.

First, Jernigan will unlock the TERA from the PWP and hand it off to Jones for installation to the RMS. Jernigan will unlock the foot restraint and Jones will install it on the TERA. While Jones tries out different techniques of installation, Jernigan will unlock the tool stanchion and hand it over to Jones for installation. Once the PWP is configured, the two space walkers will set up their tools, and perform assembly and maintenance operations with both a large and a small ORU.

During the space walk, Jernigan and Jones also will evaluate ORU carriers. These carriers will be attached to the shuttle cargo bay for transport to the station. The astronauts must develop techniques for removing new ORUs, parts such as batteries, from these carriers and replacing old equipment for shipment back to Earth. Jernigan and Jones will evaluate operations with a simulated space station battery and its carrier while utilizing both the crane and the PWP.

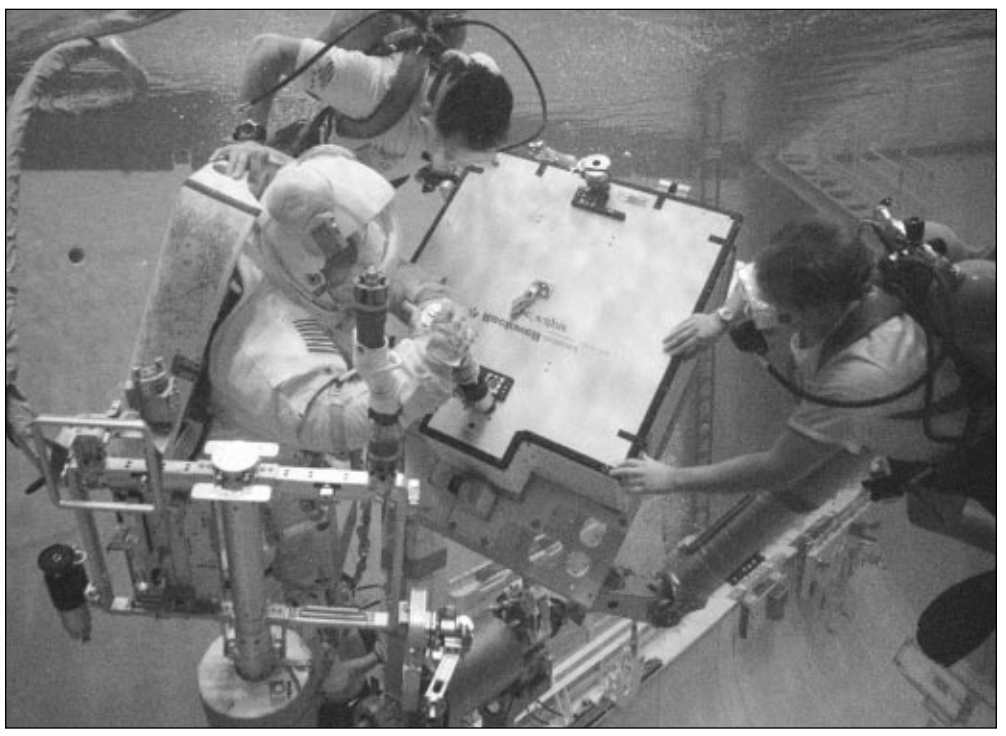
"Once the PWP is assembled on station, we don't want to take it apart every time, so we want to get the experience of handling this fully assembled work platform," Schuck said.

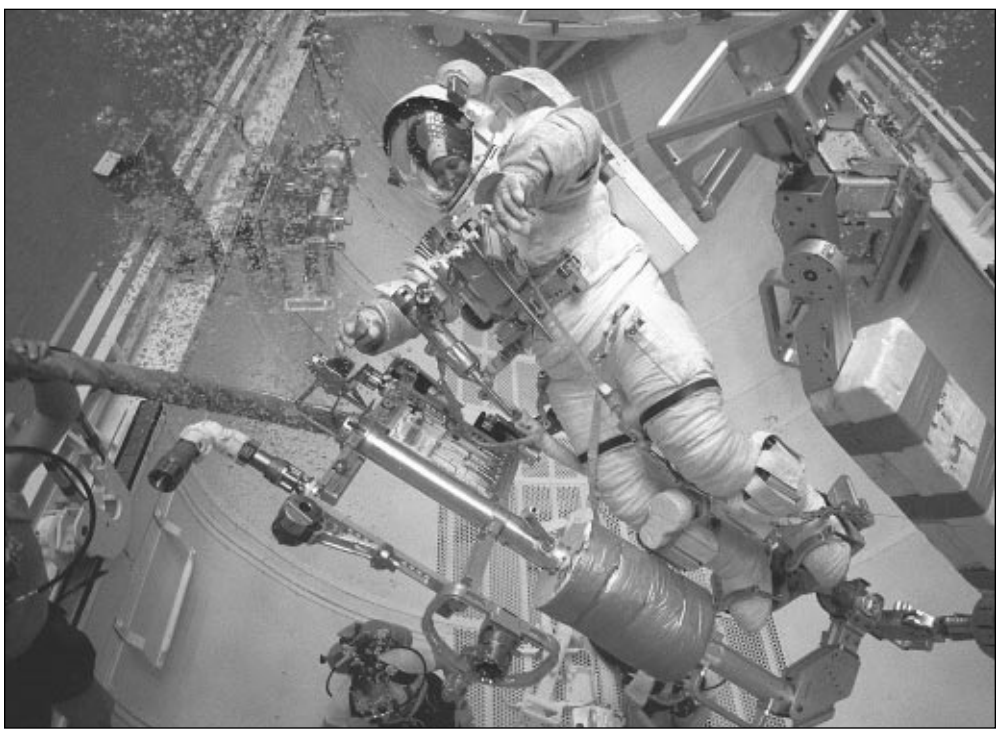
Also being evaluated during the two EVA's are eight modified and 11 new EVA tools including the space station power tool.

"The space station power tool is a smart power tool with a micro processor control that allows torque, turns and speed to be limited," said Tim Brady, EVA equipment project manager. "It also stores information on fault diagnostics and output events that are taking place."

During both space walks, several tethers and body restraint aids also will be evaluated for crew members and station equipment. The astronauts will evaluate the best position for these tethers and body restraint aids for ease in working in microgravity.

"As space station EVA hardware providers, the EVA Development Flight Test program is a tremendous opportunity for us to thoroughly evaluate our hardware in realistic on-orbit operating conditions," said Brady. "All the hardware on STS-80 is operationally similar or identical in function to that which will be used to support the space station." ❑





From top to bottom, left to right; 1) STS-80 Mission Specialist Tom Jones uses one of the crank handles on the EVA crane to move an Orbital Replacement Unit, or ORU in the Weightless Environmental Training Facility; 2) STS-80 Mission Specialist Tammy Jernigan and Jones will evaluate several tools during the STS-80 space walks including a D-handle, square and round scoops; 3) This animation still depicts how Jones and Jernigan will attach handles and remove ORUs from carriers in *Columbia*'s cargo bay; 4) This animation still shows how Jones and Jernigan will mount an ORU on the Temporary Equipment Restraint Aid and practice mass handling techniques; 5) With the help of WETF divers, Jones attaches a scoop to the ORU while working on the Portable Work Platform; 6) Jernigan works on the Portable Work Platform evaluating assembly and maintenance techniques that will be used on the International Space Station. JSC Photos by Mark Sowa